The Embedded Curved Boundary Technique in Massively Parallel ADI

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Although the Alternating Direction Implicit (ADI) method has demonstrated very exciting convergence properties for strongly coupled elliptic systems of general interest in plasma and fluid simulations, it has until recently not been convenient to implement on Massively Parallel Processing (MPP) computers. Further, the apparent inability of ADI to address more than the simplest "stair step" internal boundaries have resulted in the decline of the popularity of ADI. We report here our recent extension of ADI to address both of these problems: 1) We have recently invented a new technique to solve banded linear systems efficiently on MPP hardware. When implemented in ADI elliptic methods, we find further advantages: not only does the domain assigned to each processor *not* have to be adjusted for each alternate direction in an iteration, but the domains can be laid out in an optimal pattern for the remainder of the code that this solution technique supports. 2) We have recently implemented an Embedded Curved Boundary (ECB) technique that integrates well with the basic MPP-capable ADI method. The ECB technique allows boundaries consisting of connecting piece-wise-linear boundary elements to influence nearby elliptic equation finite-difference coefficients so that most of the fidelity of finite elements methods can be achieved while retaining the speed of the MPP method. Results demonstrating these capabilities will be presented.

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